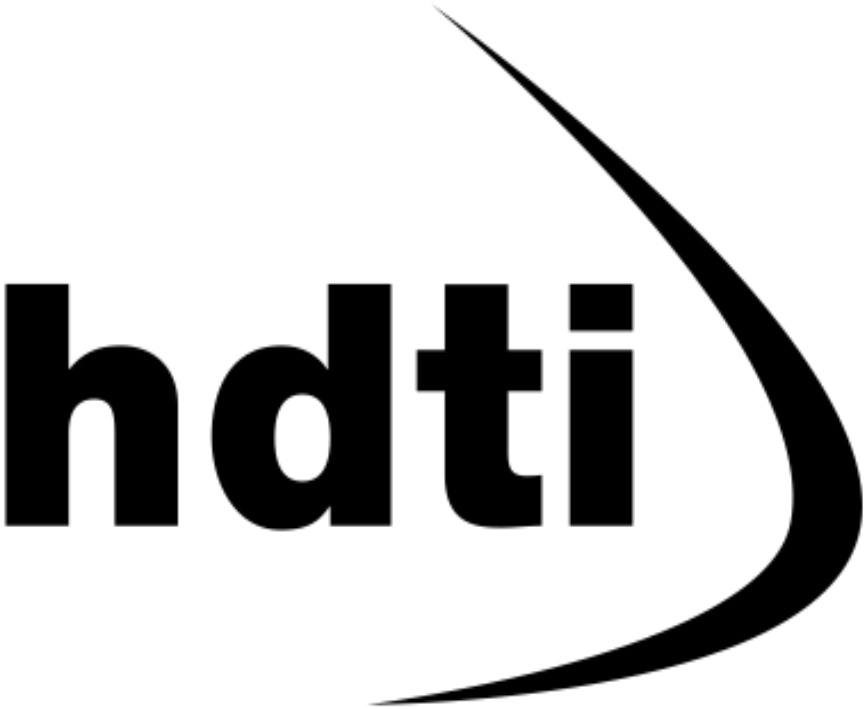
Wheelchair stability assessment: user and market needs

Evans, J., Moody, L., Stefanov, D., Fielden, S., Magee, P., Heelis, M., Dryer, P. and Shapcott, N.



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Wheelchair stability assessment: User and Market needs

Jill Evans – Research Assistant, HDTI
Dr. Louise Moody – Reader, Coventry University
Dr. Dimitar Stefanov –Principal Lecturer, Coventry University
Simon Fielden – Director, HDTI
Paul Magee – Senior product designer, HDTI
Mike Heelis – Birmingham Community Healthcare NHS Trust
Paul Dryer – Kings College NHS Foundation Trust
Nigel Shapcott – Betsi Cadwaladr University Health Board

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Overview

- Wheelchair stability
- Ramp tests
- Load cell tests
- The project so far
- Online survey
- Prescriber interviews
- Conclusions from research
- Requirements for a new system
- Development of a new system

Wheelchair stability

- Loss of wheelchair stability can lead to chairs tipping, potentially resulting in injury or death
- Conversely, wheelchairs can also become ‘too stable’, leading to propulsion difficulties
- Accidents result from loss of stability on ramps, slopes, steps, kerbs, soft ground or due to modifications (e.g. to carry ventilators) which changes the wheelchair’s centre of gravity
- User fear of tips/slides is common, resulting in anxiety and reduced independence.
- Risk of tipping needs to be balanced against users’ mobility goals

Testing stability

- Stability testing is undertaken by rehab engineers, OTs, wheelchair manufacturers and suppliers in some situations

- Prescription involves reconfiguring the chair to match:
  - User characteristics
  - User ability, competence and confidence
  - Environmental features and conditions
  - Modifications and accessories

- Tuning aims to improve the chair’s performance

How do we test stability?

- Various ways to test for wheelchair stability
- Most widely used in UK:
  - Fixed ramps
  - Variable ramps
- Load cells increasing in use
- Some services not testing at all
- Testing usually conducted in atypical chair use

Ramp tests

- Two types of ramp test: fixed and variable
- Manual test
- Pass/fail
- Demonstrates real tipping to client
- Can be physically difficult to use
- Low level of accuracy
- Can be unpleasant for clients

Ramp tests

- Most wheelchair services in the UK assess wheelchair stability (for specific cases) by using a static inclined ramp test

- Involves positioning a wheelchair and occupant on a ramp forwards, backwards and sideways to see if the chair tips.
- The test is done at 12° for attendant push wheelchairs, and 16° for self propelled and electric wheelchairs.
- Ramp weighs 7.8kg, and folds up to be carried around

Load cell tests

- Based on car technology
- Uses weighing plates to determine centre of gravity
- Hardware and software work together
- Can be used to model different scenarios
- Requires some technical skill
- Time consuming to set up
- Less distressing for client

Load cell tests

- Calculates the position of the centre of gravity using 4 load cells- 1 under each wheel

- Intercomp scales for weighing cars - durable and capable of weighing up 70 stone.

- An aluminium framework to hold the cells and be adjustable for a variety of wheelchair sizes

Project to date

- This project aims to bring to the point of commercialisation a system that:
  - Facilitates the stability testing of wheelchairs
  - Predicts dynamic stability as well as static stability in different situations
  - Offers expert knowledge to support the wheelchair prescriber in tuning the wheelchair to an individual patient's needs
- A user-centred design approach is being adopted initially through:
  - A review of current stability testing methods
  - A survey of user and market needs

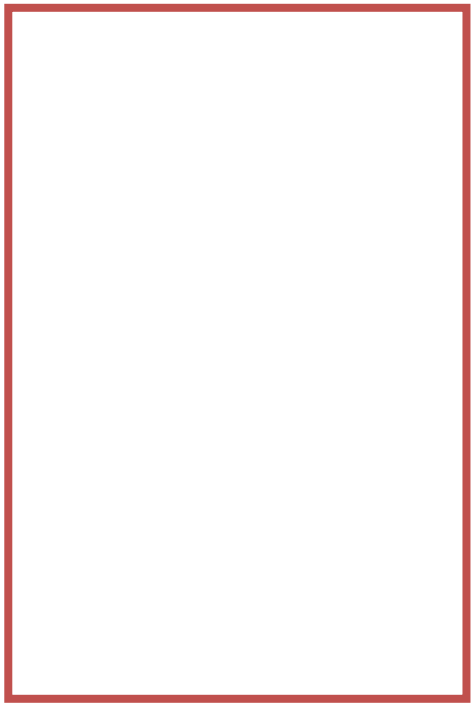
A new system – what do users want?

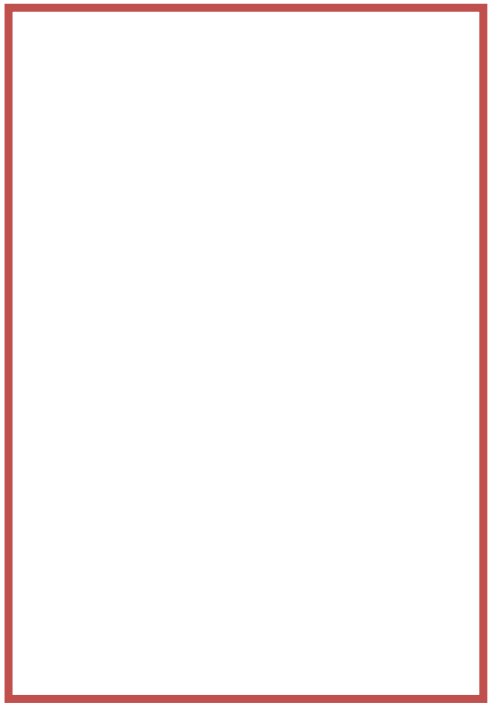
- Online survey and prescriber interviews conducted during 2012
- 98 survey participants (48 completers) from a range of sources
  - 48 engineering/tech, 27 therapeutic/medical
- 17 semi-structured interviews in Birmingham, London, Wales
  - 9 REs, 2 OTs, 6 others
- Interviews aimed to build on survey findings

Findings: Online survey

Types of patients requiring stability tests

- Special seating
- Amputees
- Variable seating requirements





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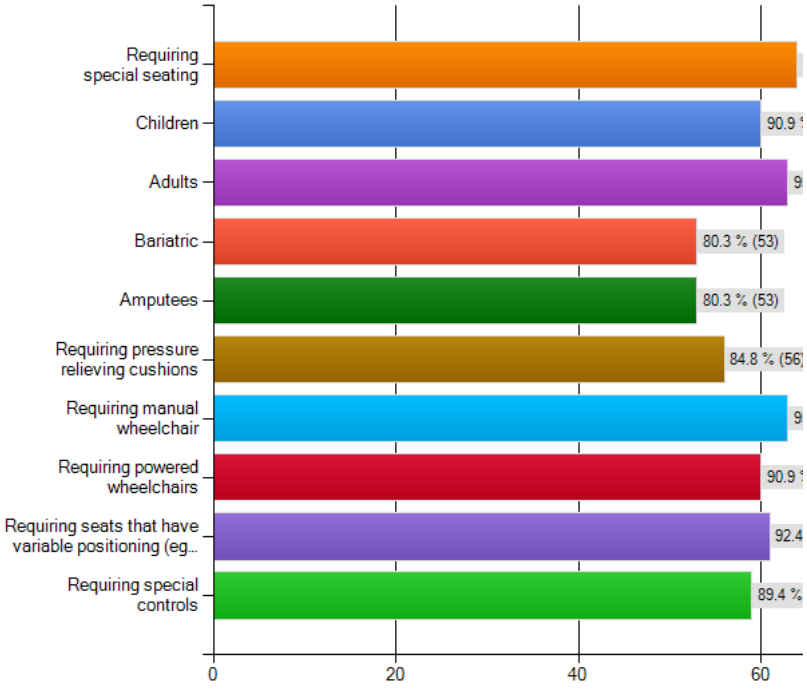
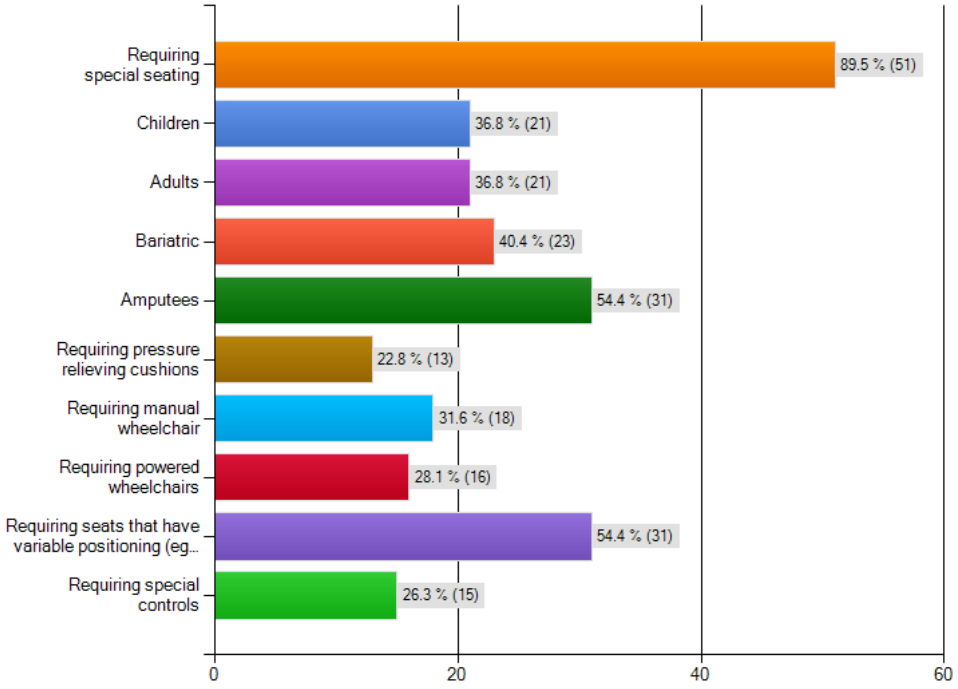
What types of patients do you see in your service? [Please select all that



For which cases do you usually conduct a stability test? [Please select all that apply]



Findings: Online survey

- Ramp tests:
  - Static stability > dynamic stability
  - Issues with manual handling and client experience
- Load cell tests:
  - Static stability > dynamic stability
  - Issues with time taken to complete test
- Large range in estimated numbers of prescriptions (6-500 per service per month)
- Factors considered during prescription:
  - Environment
  - Client ability
  - Physical attributes of chair and user
  - Centre of gravity/ stability
  - Carer needs/lifestyle

Findings: Online survey

- Limitations of current methods:
  - Lack of dynamic stability capability
  - Lack of portability and practicality
  - Subjectivity of results
  - The client experience

- Desirable functions of a new system:
  - Providing a record of the stability assessment process
  - Capacity to educate the client/carer
  - Determining the maximum slope on which the chair is safe
  - Providing indication of tipping angles
  - Ability to model/predict the effects of different configurations on stability

Findings: Prescriber interviews

- Ramp tests:
  - Cost effective but not ideal
  - Unpleasant client experience
  - Accuracy can be compromised
  - Client can feel the ‘real’ angle of tip
  - Manual handling issues
  - Not reflective of real environment
  - Not in keeping with modern equipment
- Load cell tests:
  - Not consistently or widely used
  - Seen as complex but useful
  - Lack of ‘real’ user experience (angles of tilt)

Findings: Prescriber interviews

- Desirable features of a new system:
  - Improved accuracy
  - Portability
  - Ease of use
  - Ability to support record keeping
  - Cost effective/ value for money
  - Ability to support client/carer education

Cost

- Survey respondents unable to offer definitive value of a new system
- Estimated to be around £2-4k
- Interviews confirmed that the system would need to demonstrate value beyond that of current methods
- Further investigation into the market underway

Perception of ‘stability’ and risk

- Stability testing not standard for all clients
- Variance in interpretation of stability
- Variance in level of training in assessment methods
- Stability vs. manoeuvrability
- ‘Risk assessment’ interchangeable with ‘stability testing’

Conclusions

- Survey and interviews both support development of a new system

- ‘Stability’ not a clearly defined concept
  - Static vs. dynamic
  - When to test for stability
  - Active use

System specification

- Mark 1:
  - For 4 wheeled chairs
  - Hardware + software
  - PDF output
  - Supports clinical judgement
  - Portable
  - Easily stored
  - Static stability
  - Less distressing for client
- Mark 2:
  - Include 6 wheeled chairs
  - Wireless
  - Back-end data
  - Dynamic stability
  - System improvements

Next steps

- System development underway
- Evaluation begins 2013
  - Case studies
  - Prescriber feedback
  - Technical development
- Prototype development for Mk2

Project Team

- Jill Evans – Research Assistant, HDTI
  - jevans@cad.coventry.ac.uk
- Dr. Louise Moody – Reader, Coventry University
  - L.moody@coventry.ac.uk
- Dr. Dimitar Stefanov –Principal Lecturer, Coventry University
- Simon Fielden – Director, HDTI
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